I claim:

1. A method for determining coefficient values for a shortening impulse response filter (SIRF), said method comprising the steps of:

establishing at least one set defining constraints that said SIRF filter must satisfy in a time domain;

establishing at least one set defining constraints that said SIRF filter must satisfy in a frequency domain; and

determining an intersecting set of said at least one set defining said time domain constraints and said at least one set defining said frequency domain constraints.

2. The method according to claim 1, wherein said at least one set defining constraints that said SIRF filter must satisfy in a frequency domain define a filter having a linear phase.

3. The method according to claim 1, wherein said at least one set defining constraints that said SIRF filter must satisfy in a frequency domain define a filter having a non-linear phase.

4. The method according to claim 1, wherein said time domain constraints specify a shortening of a channel impulse response.

5. The method according to claim 1, wherein said frequency domain constraints include a frequency response for said SIRF filter that does not attenuate a received signal.

6. The method according to claim 1, wherein said frequency domain constraints include a pass-band for said SIRF filter.

7. The method according to claim 2, wherein said at least one set defining said frequency domain constraints is defined as follows:

$$C_2 \equiv \begin{Bmatrix} \mathbf{h} \in R^N : 1-\alpha \le |H(\omega)| \le 1+\alpha \ \text{ for } \omega \in \Omega_p \\ \text{and } |H(\omega)| \le \beta \text{ for } \omega \in \Omega_s \end{Bmatrix}.$$

where h is the impulse response of length N that shortens the impulse response of a channel, H(ω) is the impulse response in the frequency domain, R^N is the Hilbert space of dimension N, Ω_p is the pass-band and Ω_S is the stop-band.

8. The method according to claim 3, wherein said at least one set defining said frequency domain constraints is defined as follows:

$$C_3 \equiv \begin{Bmatrix} \mathbf{h} \in R^N : 1-\alpha \le A(\omega) \le 1+\alpha \\ \text{and } \Phi(\omega) = -\omega(N-1)/2 \ \text{ for } \omega \in \Omega_p. \\ |H(\omega)| \le \beta \text{ for } \omega \in \Omega_s. \end{Bmatrix}.$$

where h is the impulse response of length N that shortens the impulse response of a channel, H(ω) is the impulse response in the frequency domain, R^N is the Hilbert space of dimension N, Ω_p is the pass-band, Ω_S is the stop-band, $A(\omega) = \sum_{0}^{N/2-1} 2h(n)\cos\left[\left(n - \frac{N-1}{2}\right)\omega\right]$ and $\Phi(\omega) = -\frac{N-1}{2}\omega$.

9. The method according to claim 1, wherein said determining step further comprises the step of employing vector space projection methods to determine said intersecting set.

10. The method according to claim 9, wherein said vector space projection method is iteratively applied to said at least one set defining said time domain constraints and said at least one set defining said frequency domain constraints until said sets converge to a set of coefficients satisfying said time domain constraints and said frequency domain constraints.

11. A shortening impulse response filter (SIRF), comprising:

a set of finite impulse response (FIR) coefficients satisfying at least one constraint in a time domain and at least one constraint in a frequency domain, wherein said at least one time

domain constraint is represented as at least one first set and wherein said at least one frequency domain constraint is represented as at least one second set, wherein said finite impulse response (FIR) coefficients are determined by an intersecting set of said at least one set defining said time domain constraints and said at least one set defining said frequency domain constraints.

12. The SIRF according to claim 11, wherein said at least one set defining constraints that said SIRF filter must satisfy in a frequency domain define a filter having a linear phase.

13. The SIRF according to claim 11, wherein said at least one set defining constraints that said SIRF filter must satisfy in a frequency domain define a filter having a non-linear phase.

14. The SIRF according to claim 11, wherein said time domain constraints specify a shortening of a channel impulse response.

15. The SIRF according to claim 11, wherein said frequency domain constraints include a frequency response for said SIRF filter that does not attenuate a received signal.

16. The SIRF according to claim 11, wherein said frequency domain constraints include a pass-band for said SIRF filter.

17. The SIRF according to claim 11, wherein said intersecting set is determined by employing vector space projection methods.

18. The SIRF according to claim 17, wherein said vector space projection method is iteratively applied to said at least one set defining said time domain constraints and said at least one set defining said frequency domain constraints until said sets converge to a set of coefficients satisfying said time domain constraints and said frequency domain constraints.

19. A system for determining coefficient values for a shortening impulse response filter (SIRF), said system comprising:

a memory that stores computer-readable code; and

a processor operatively coupled to said memory, said processor configured to implement said computer-readable code, said computer-readable code configured to:

establish at least one set defining constraints that said SIRF filter must satisfy in a time domain;

establish at least one set defining constraints that said SIRF filter must satisfy in a frequency domain; and

determine an intersecting set of said at least one set defining said time domain constraints and said at least one set defining said frequency domain constraints.

20. The system according to claim 19, wherein said at least one set defining constraints that said SIRF filter must satisfy in a frequency domain define a filter having a linear phase.

21. The system according to claim 19, wherein said at least one set defining constraints that said SIRF filter must satisfy in a frequency domain define a filter having a non-linear phase.

22. The system according to claim 19, wherein said time domain constraints specify a shortening of a channel impulse response.

23. The system according to claim 19, wherein said frequency domain constraints include a frequency response for said SIRF filter that does not attenuate a received signal.

24. The system according to claim 19, wherein said frequency domain constraints include a pass-band for said SIRF filter.

25. The system according to claim 20, wherein said at least one set defining said frequency domain constraints is defined as follows:

$$C_2 \equiv \left\{ \begin{array}{l} \mathbf{h} \in R^N : 1-\alpha \le |H(\omega)| \le 1+\alpha \;\; \text{for } \omega \in \Omega_p \\ \text{and } |H(\omega)| \le \beta \text{ for } \omega \in \Omega_s \end{array} \right\}.$$

where h is the impulse response of length N that shortens the impulse response of a channel, H(ω) is the impulse response in the frequency domain, R^N is the Hilbert space of dimension N, Ω_p is the pass-band and Ω_s is the stop-band.

26. The system according to claim 21, wherein said at least one set defining said frequency domain constraints is defined as follows:

$$C_3 \equiv \left\{ \begin{array}{l} \mathbf{h} \in R^N : 1-\alpha \le A(\omega) \le 1+\alpha \\ \text{and } \Phi(\omega) = -\omega(N-1)/2 \;\; \text{for } \omega \in \Omega_p. \\ |H(\omega)| \le \beta \text{ for } \omega \in \Omega_s. \end{array} \right\}.$$

where h is the impulse response of length N that shortens the impulse response of a channel, H(ω) is the impulse response in the frequency domain, R^N is the Hilbert space of dimension N, Ω_p is the pass-band, Ω_s is the stop-band, $A(\omega) = \sum_{0}^{N/2-1} 2h(n)\cos\left[\left(n - \frac{N-1}{2}\right)\omega\right]$ and $\Phi(\omega) = -\frac{N-1}{2}\omega$.

27. The system according to claim 19, wherein said intersecting set is determined by employing vector space projection methods.

28. The system according to claim 27, wherein said vector space projection method is iteratively applied to said at least one set defining said time domain constraints and said at least one set defining said frequency domain constraints until said sets converge to a set of coefficients satisfying said time domain constraints and said frequency domain constraints.